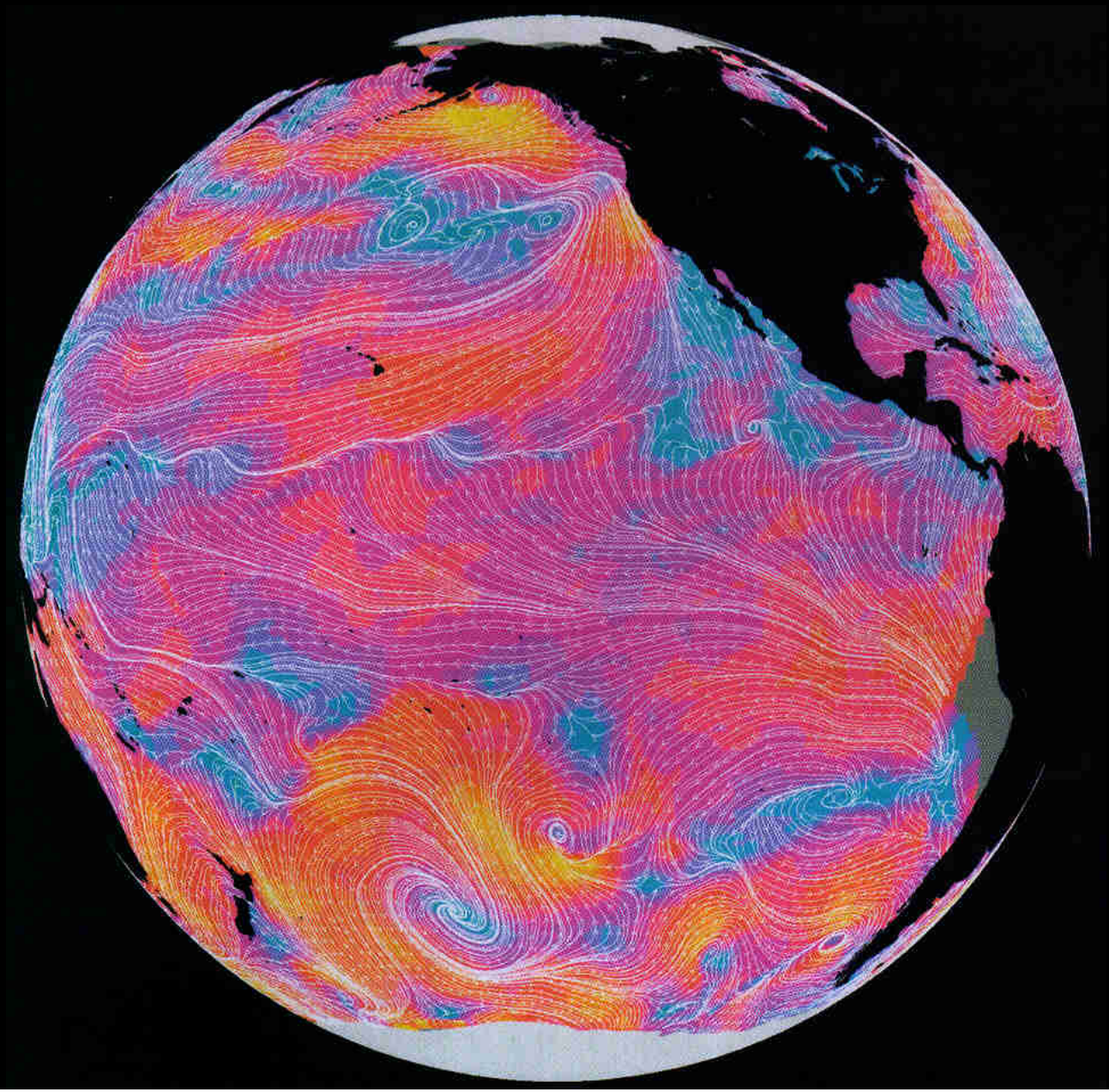
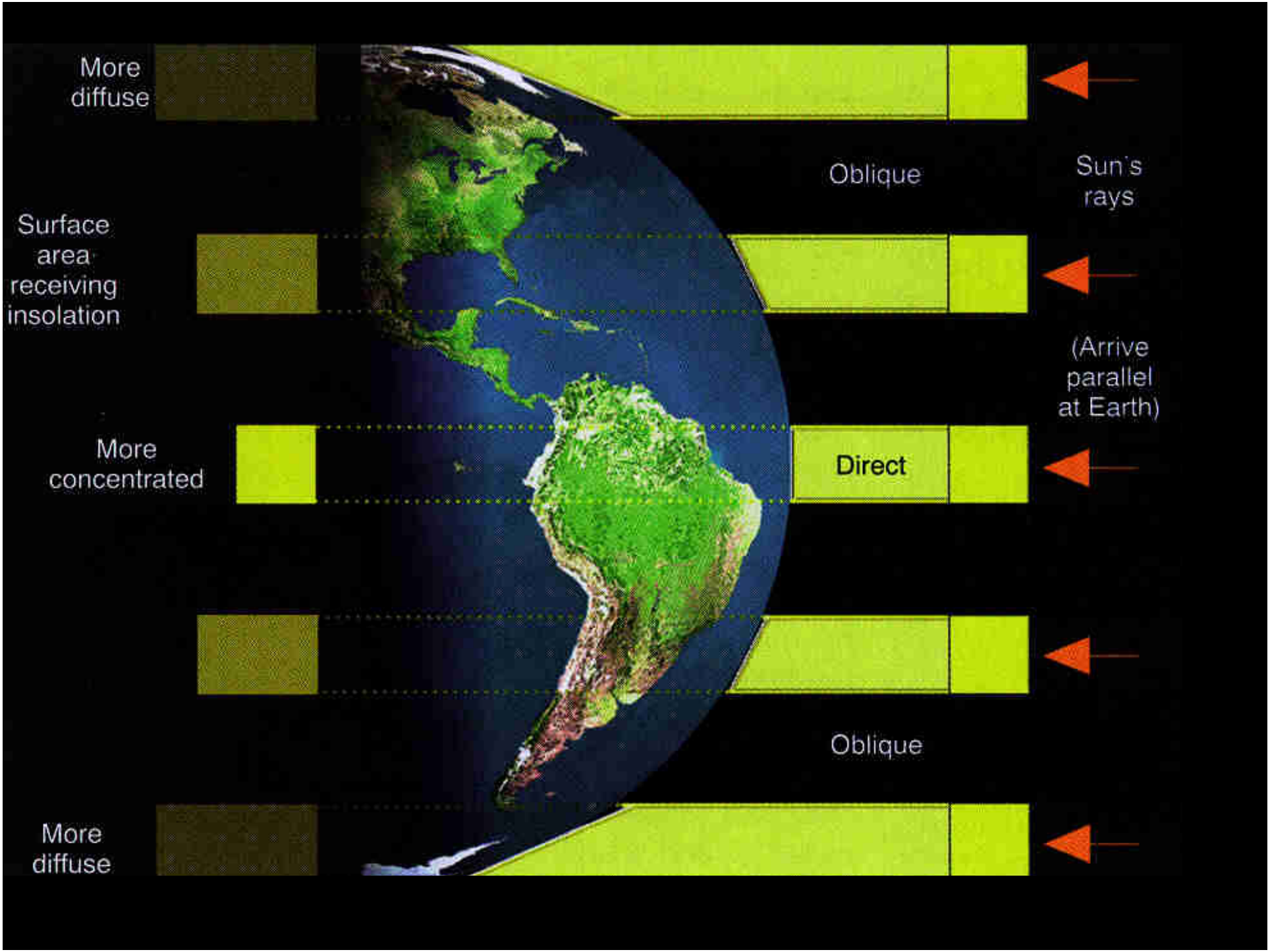
Climate and Biomes

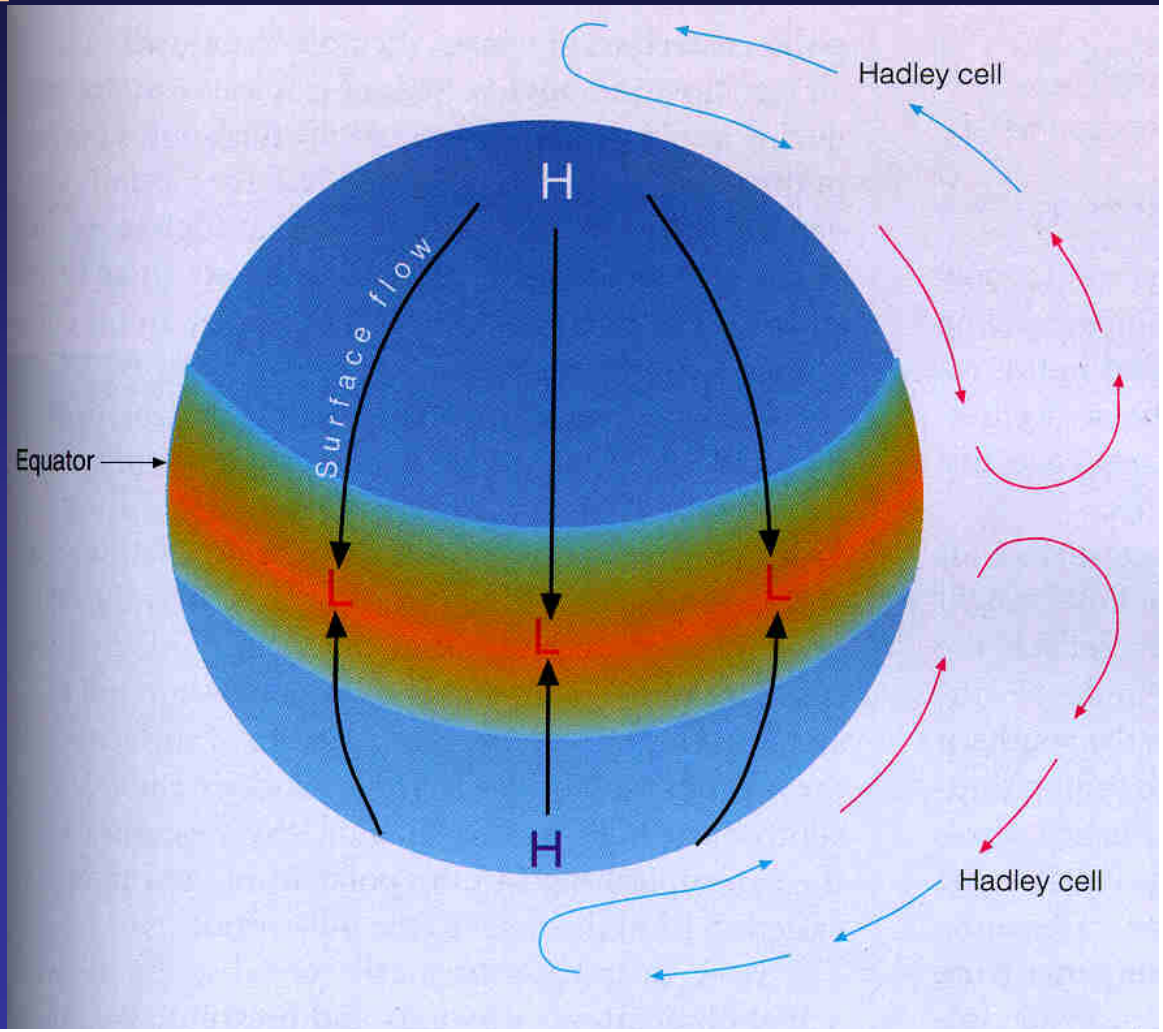



More diffuse
Oblique
Sun's rays
Surface area receiving insolation
(Arrive parallel at Earth)
More concentrated
Direct
Oblique
More diffuse

Single-Cell Model
(George Hadley, 1735)

Consider a simple model where the Earth is:

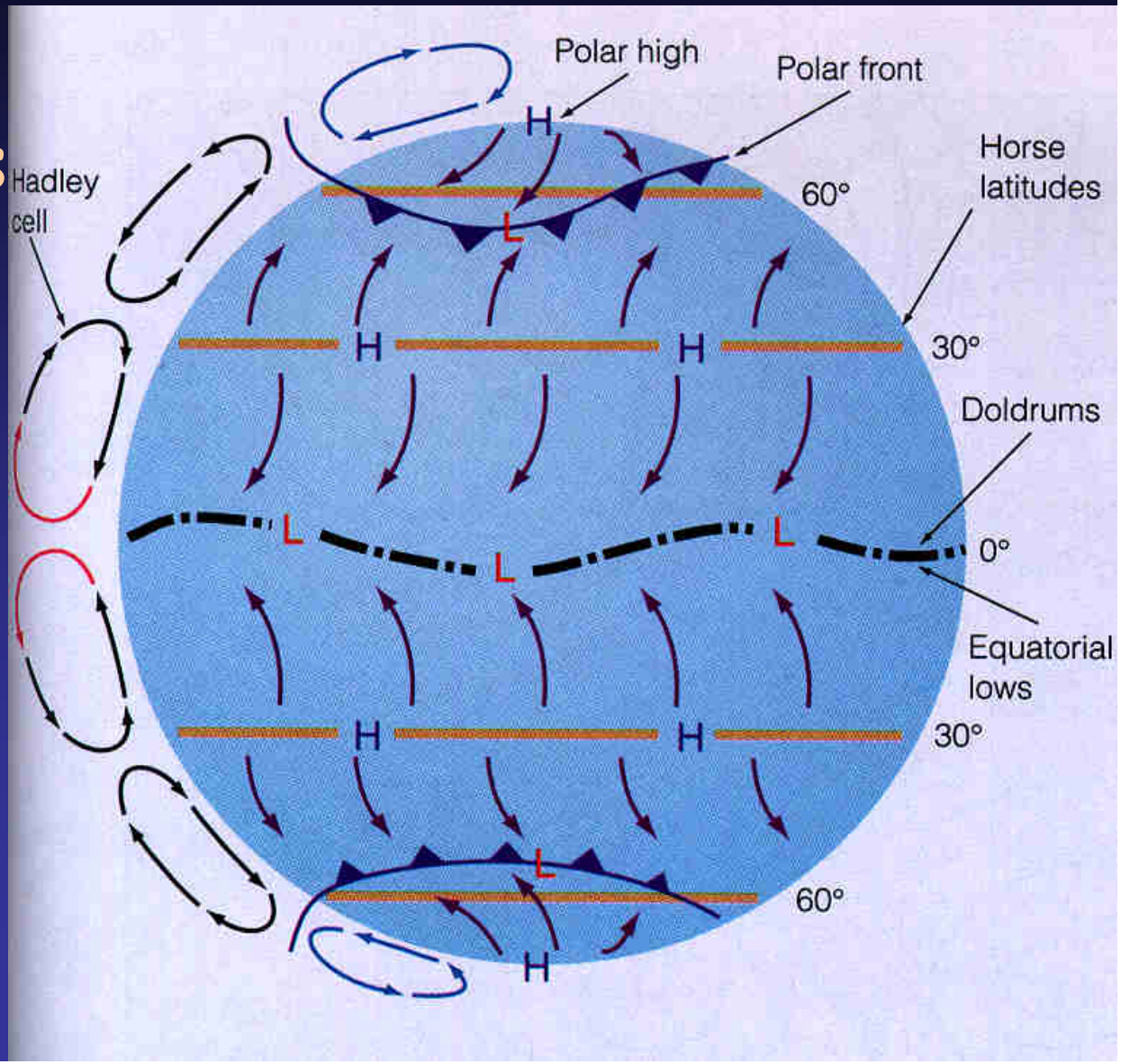
1. **uniformly covered with water**
2. **Does not rotate**
3. **Sun is always directly over the equator**

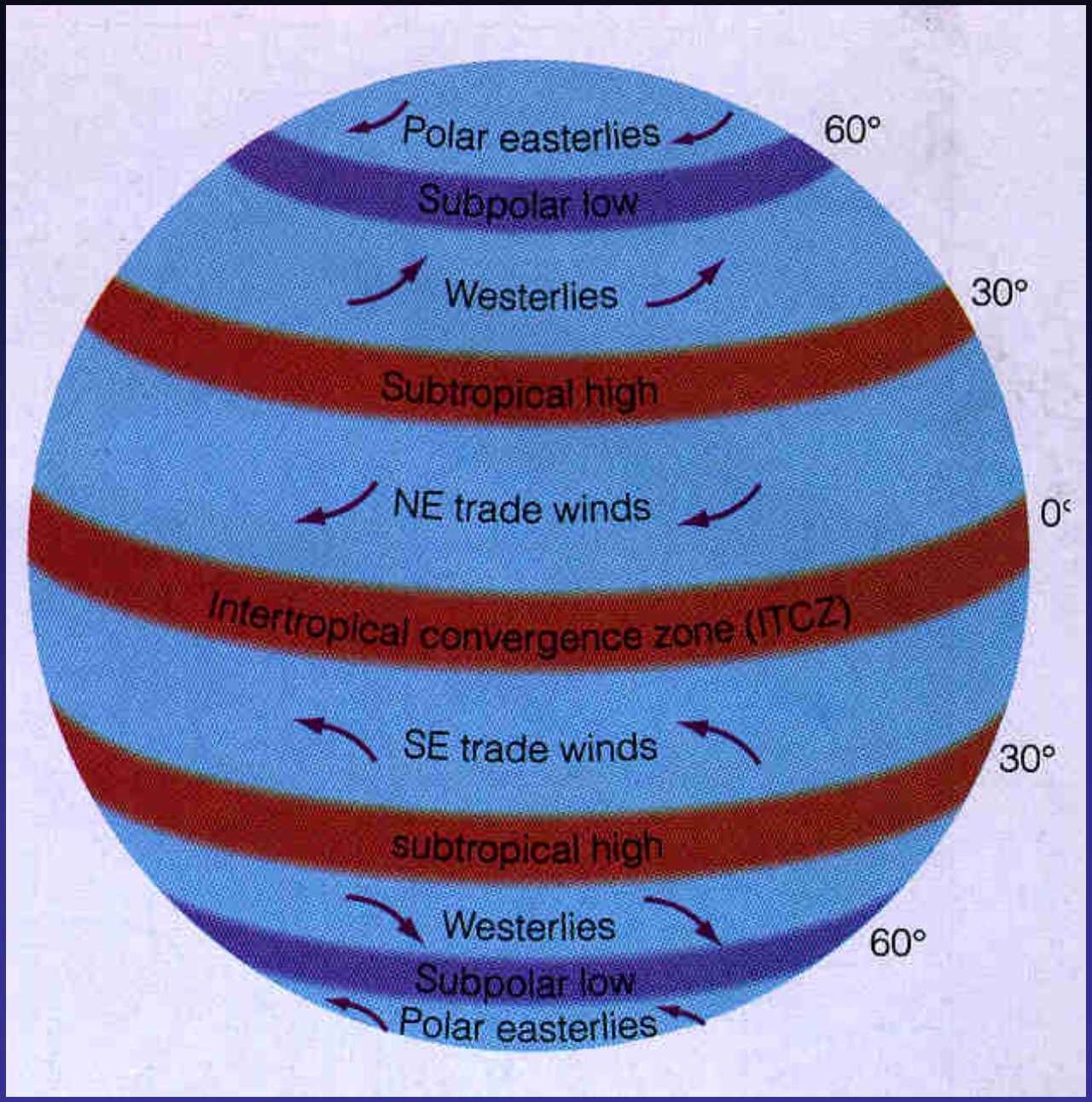


Unrealistic because of:

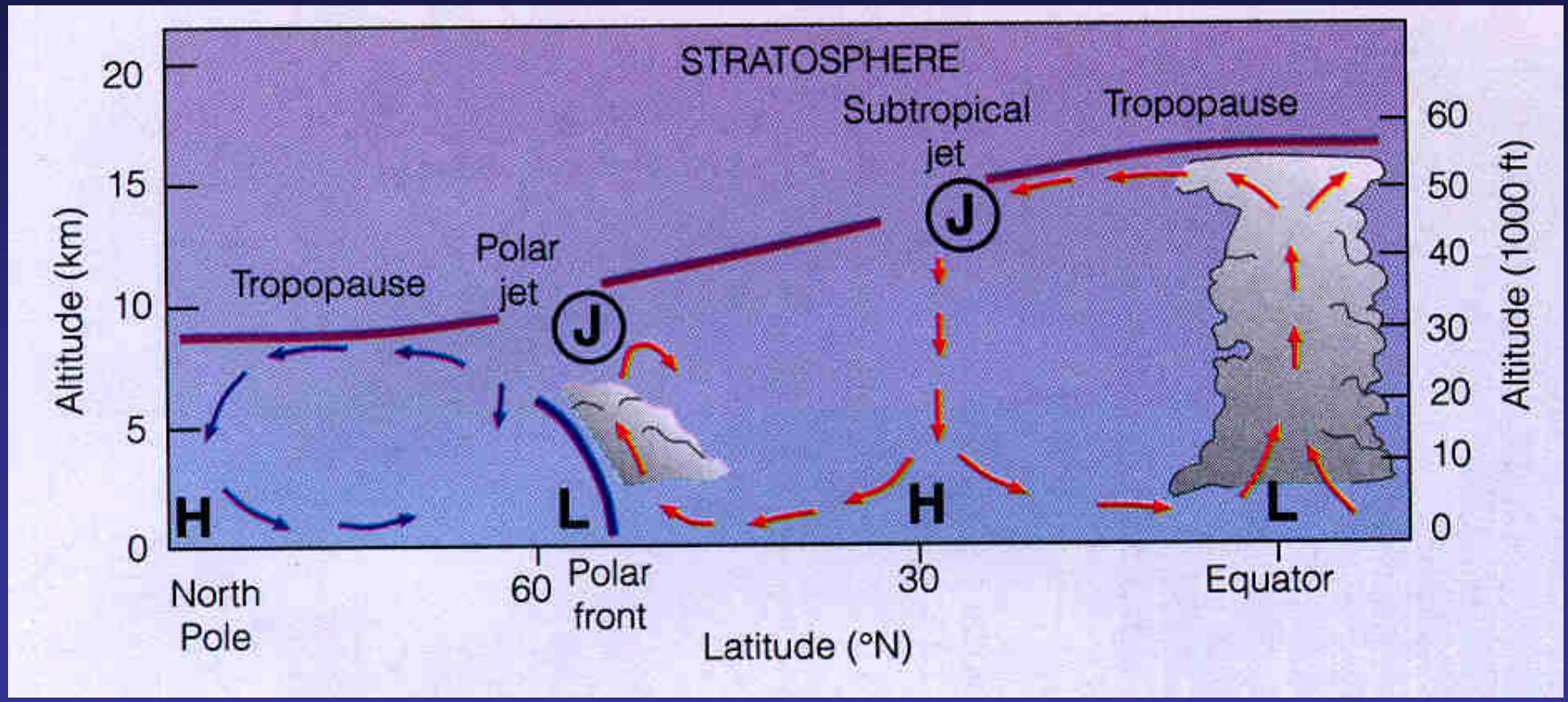
1. Coriolis effect
2. Friction
3. Tilted axis
4. Continents

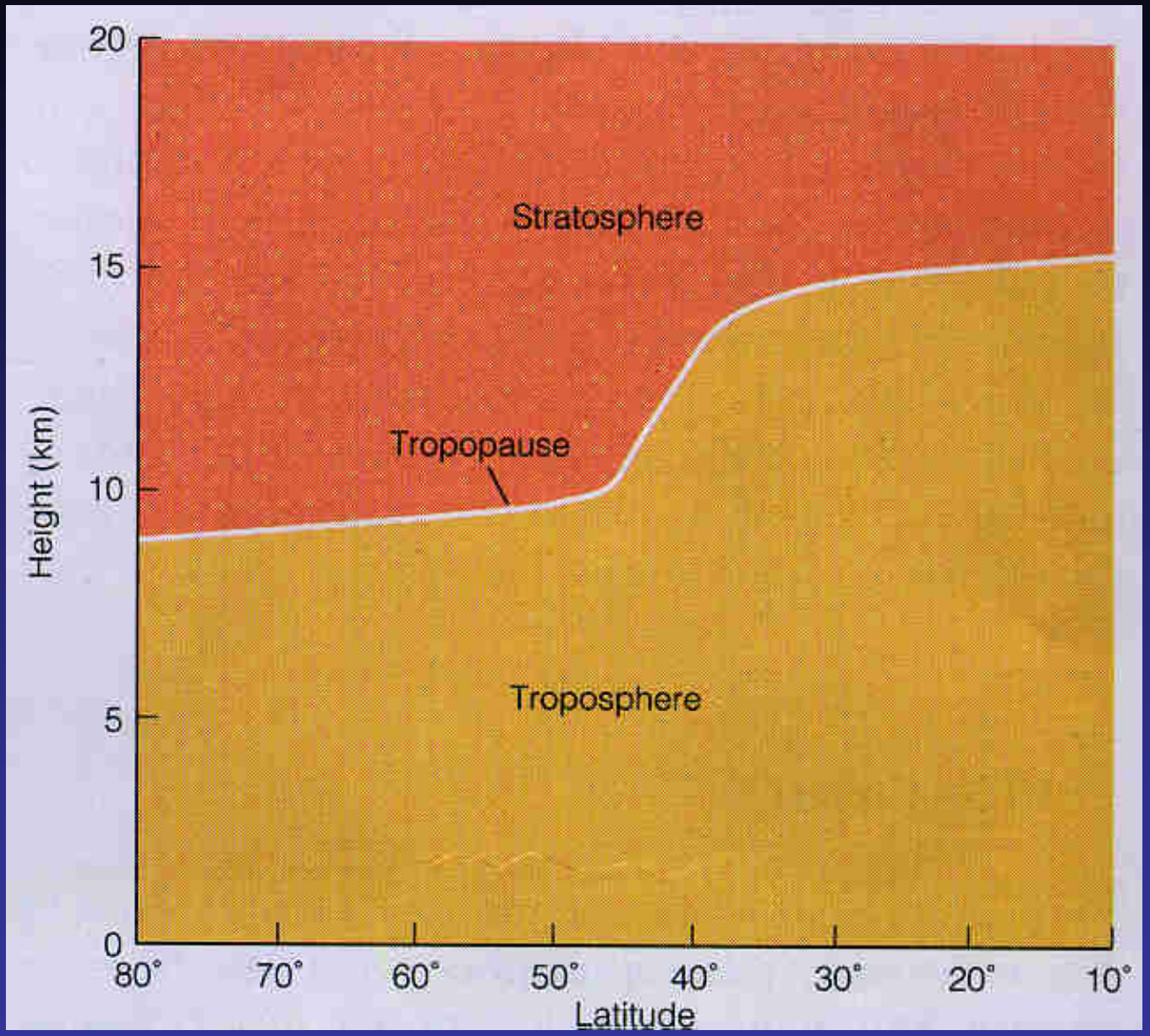
If we let the earth rotate on its axis then we get a 3-cell model



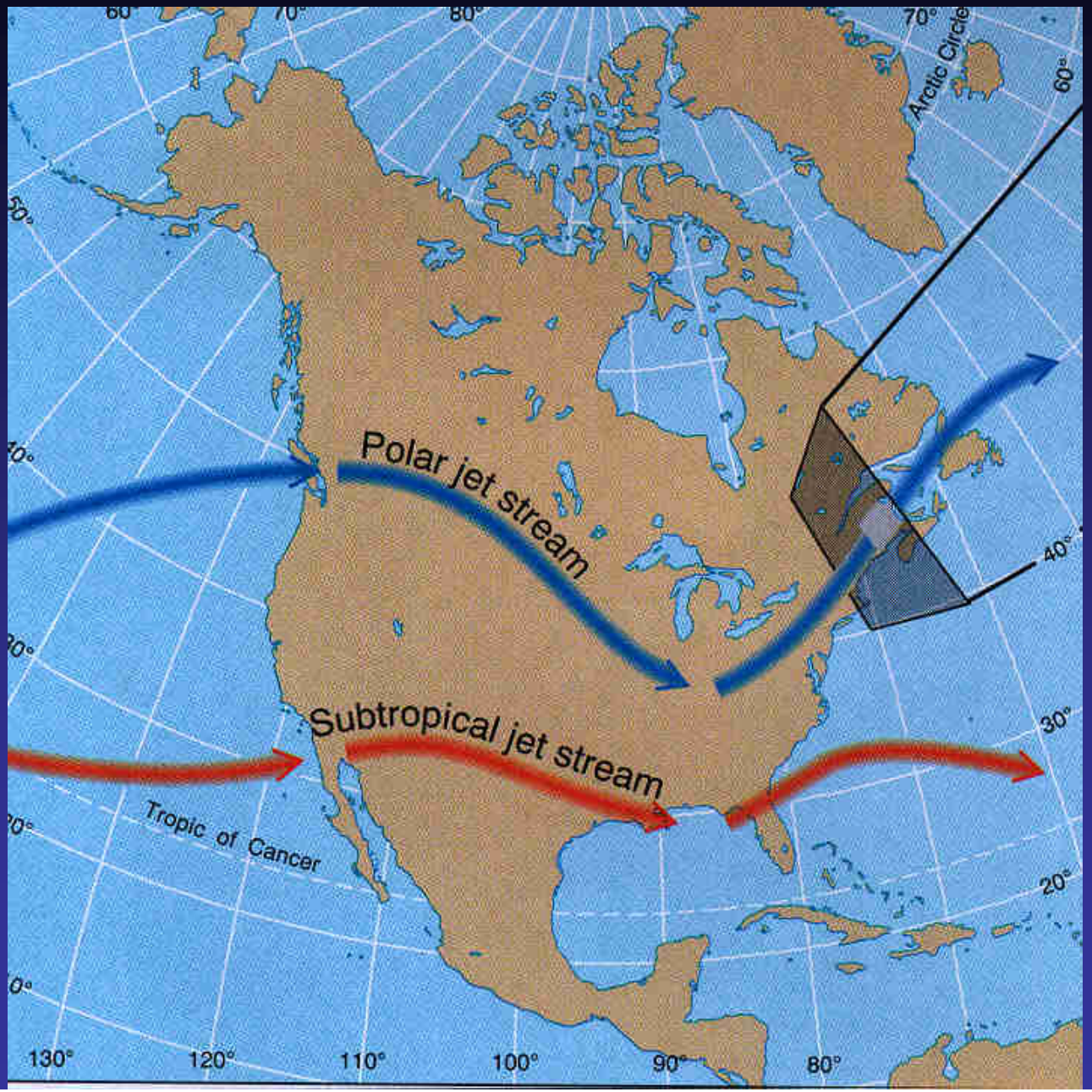

Polar easterlies
60°
Subpolar low
Westerlies
30°
Subtropical high
NE trade winds
0°
Intertropical convergence zone (ITCZ)
SE trade winds
30°
subtropical high
Westerlies
60°
Subpolar low
Polar easterlies

Jet Streams = *swiftly flowing air currents 1000's of km long, 100's of km wide, and 10's of km thick*

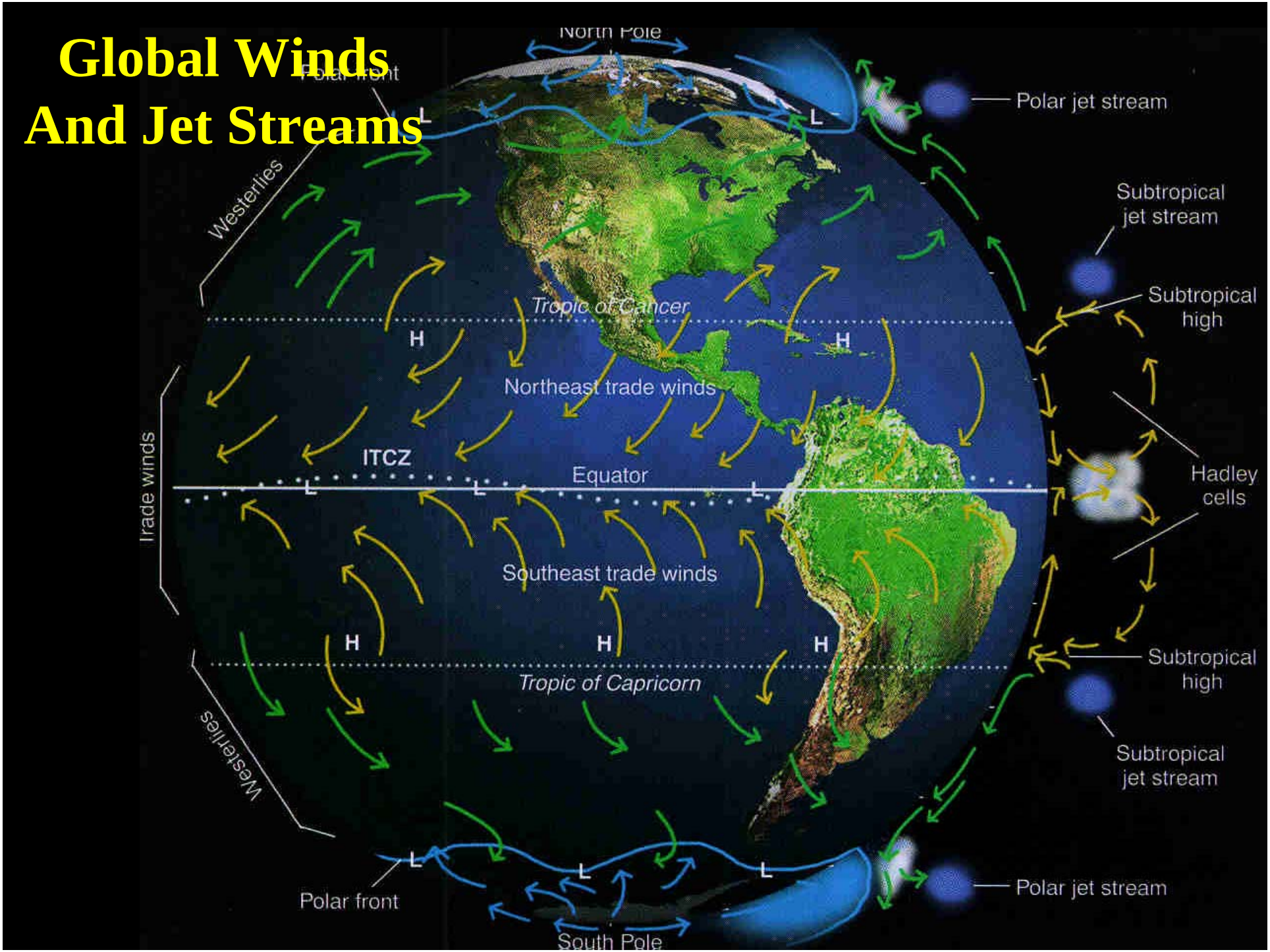



20
15
10
5
0
Height (km)
Stratosphere
Tropopause
Troposphere
80°
70°
60°
50°
40°
30°
20°
10°
Latitude

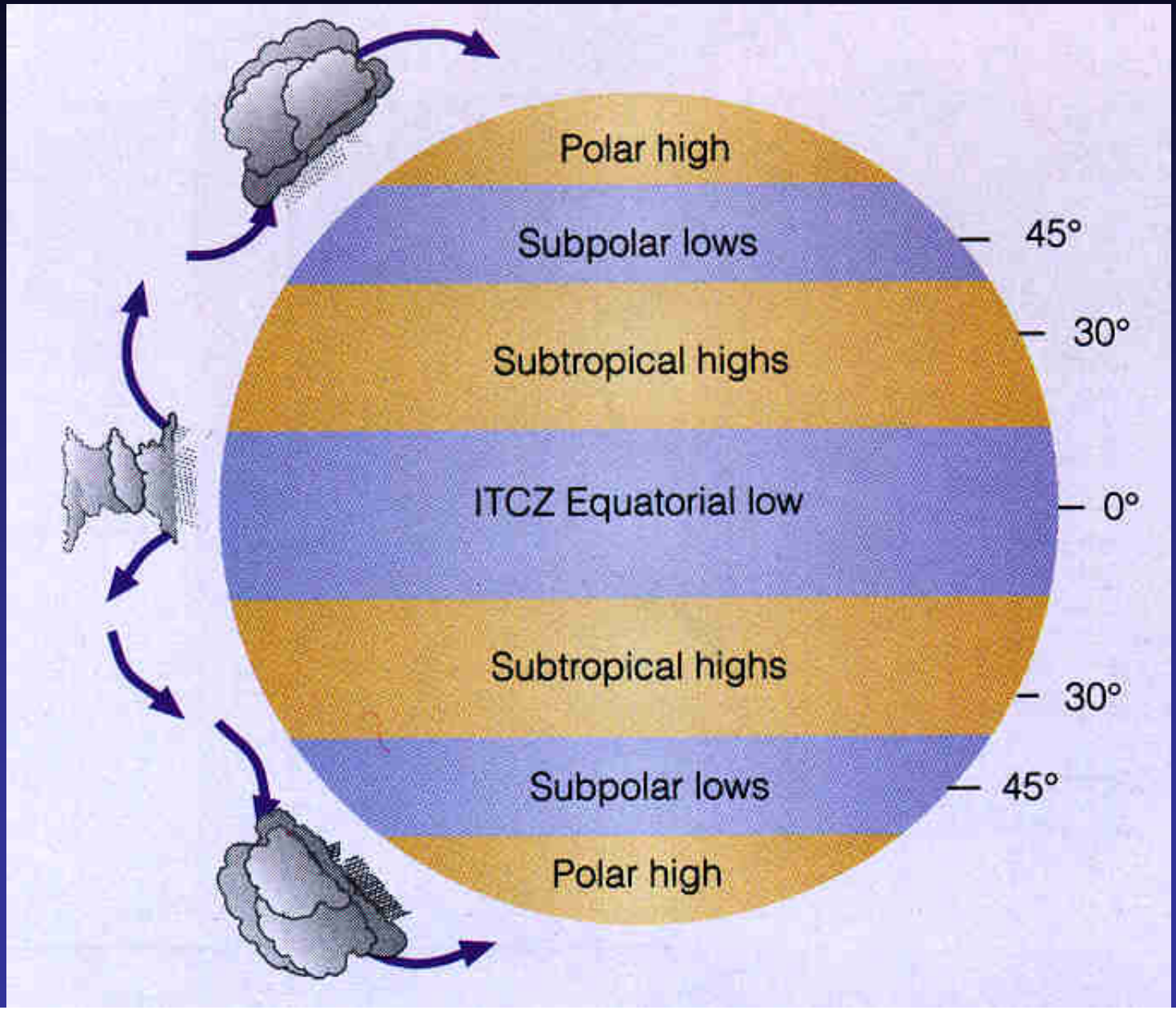
Rossby Waves



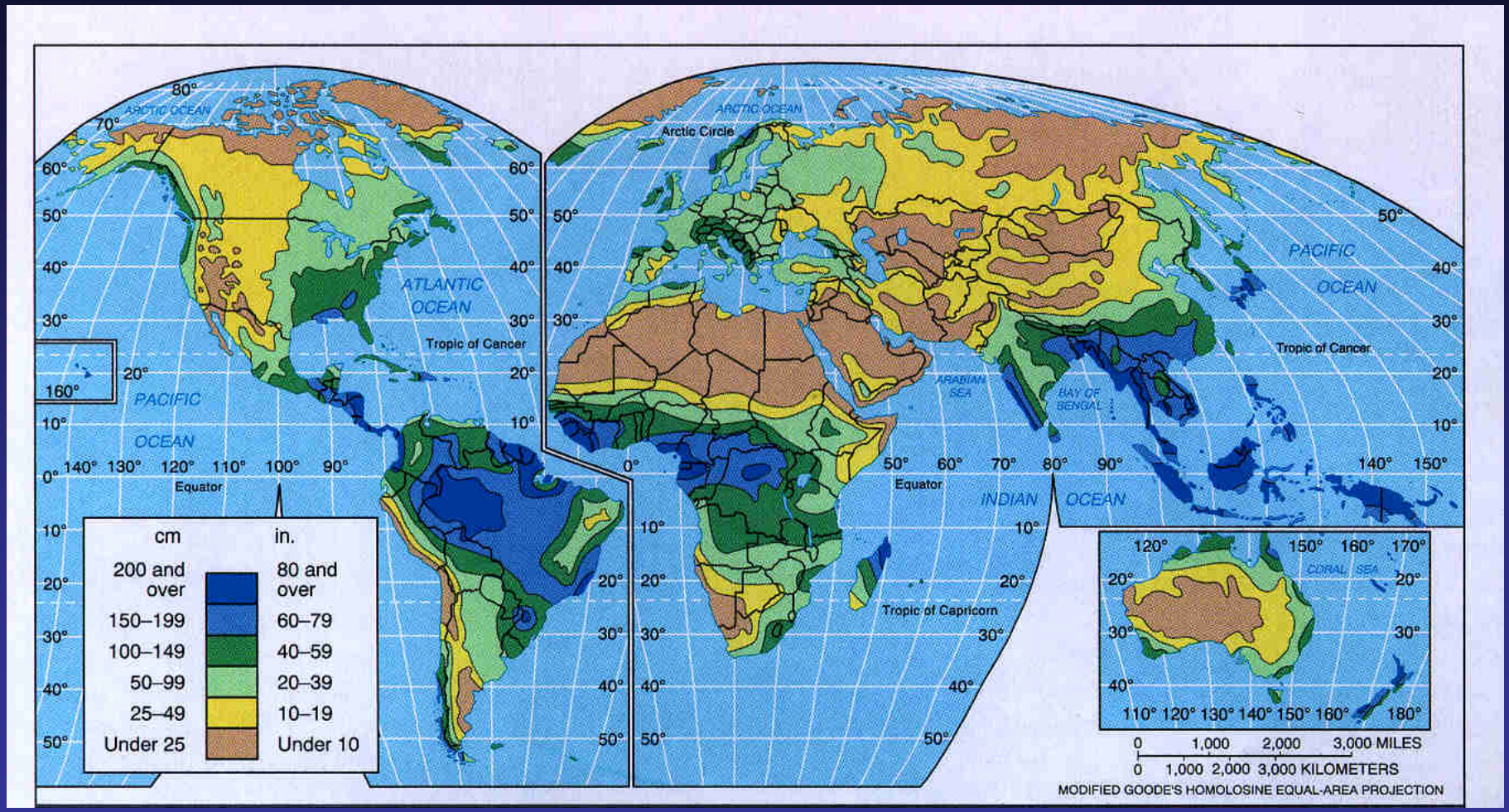
Global Winds And Jet Streams



Impact of Global Circulation on Precipitation



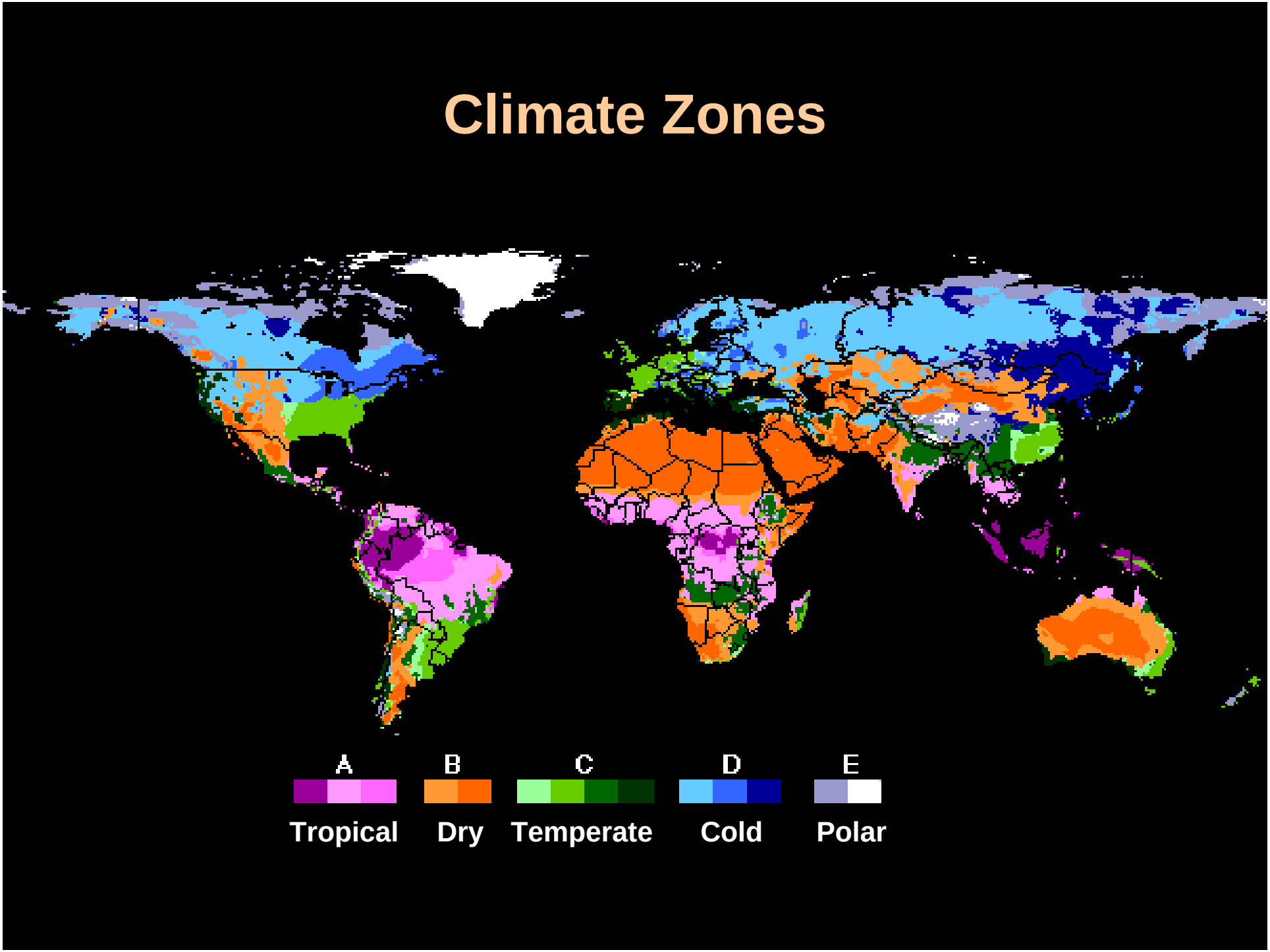
Distribution of Global Precipitation



Proximity to

- **oceans**
- **mountains**

Climate Zones



How is Climate Measured?

Climate = *long-term average of weather conditions and extremes in a region (generally a 30-year mean)*

Weather = *short-term, day-to-day condition of the atmosphere*

Weather elements or descriptors of the condition of the atmosphere include:

1. Temperature
2. Pressure
3. Relative humidity
4. Wind speed and direction
5. Cloudiness
6. Daylength
7. Sun angle

Common climate descriptors include:

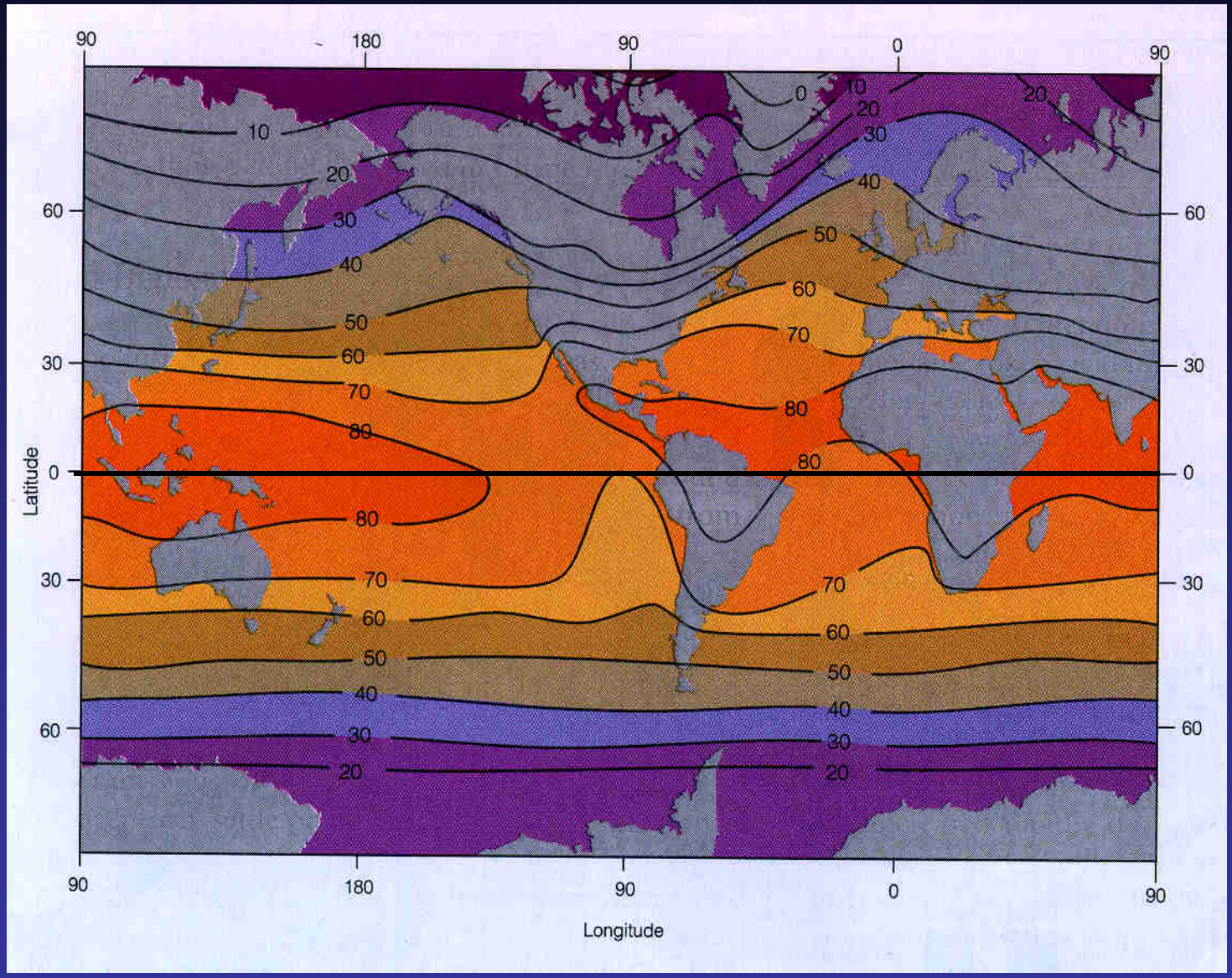
For example:

- Temperature
  - (daytime highs, nighttime lows)
- Precipitation
  - (monthly mean, cumulative)
- Solar radiation
  - (cloudiness)
- Dew point
  - (atmospheric moisture content)
- Wind speed and direction

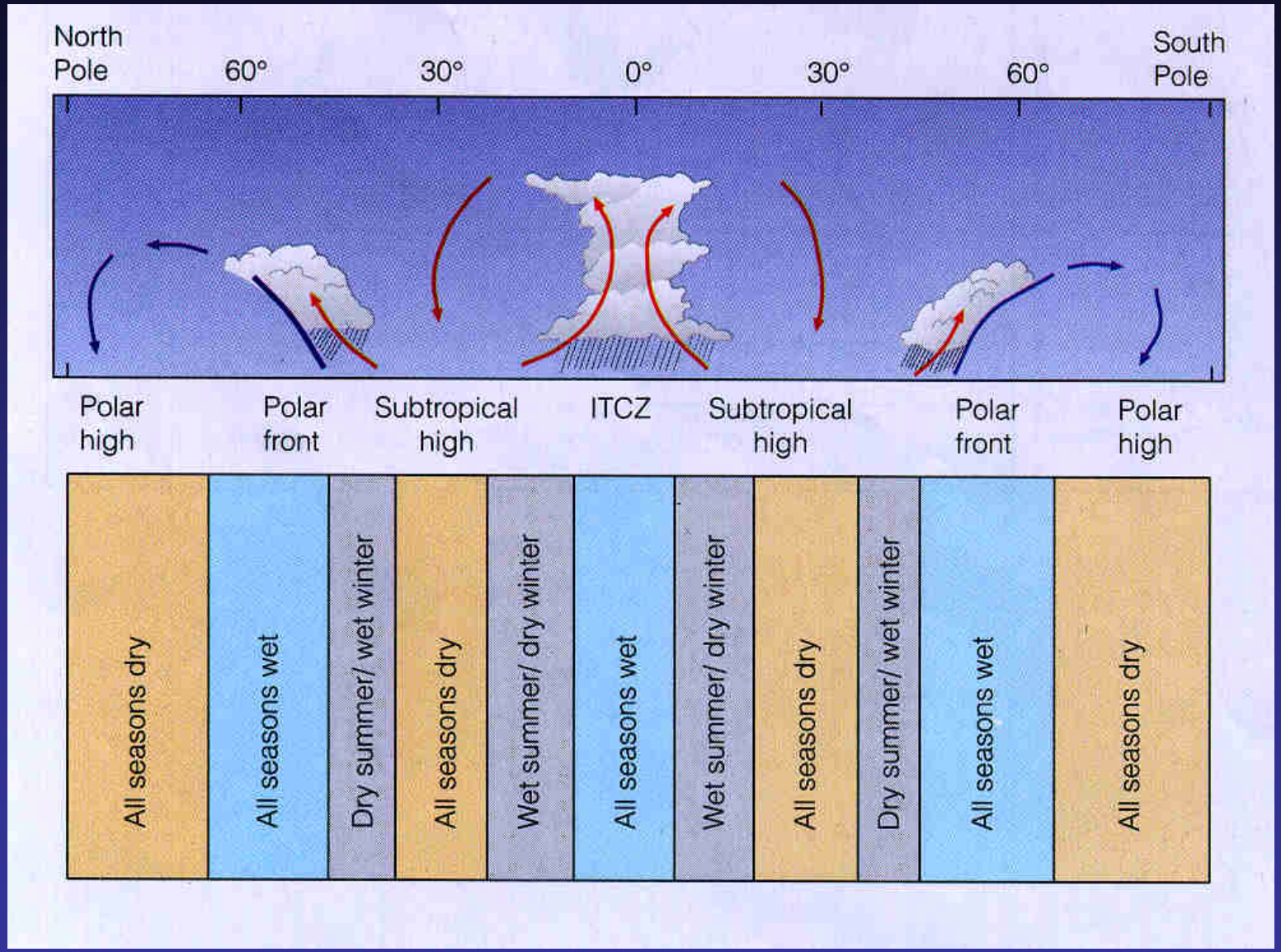
Climate Controls

1. intensity of solar radiation and its variation = latitude
2. distribution of land and water
3. ocean currents
4. prevailing winds
5. positions of high- and low-pressure
6. mountain barriers
7. altitude
8. albedo

GLOBAL TEMPERATURE



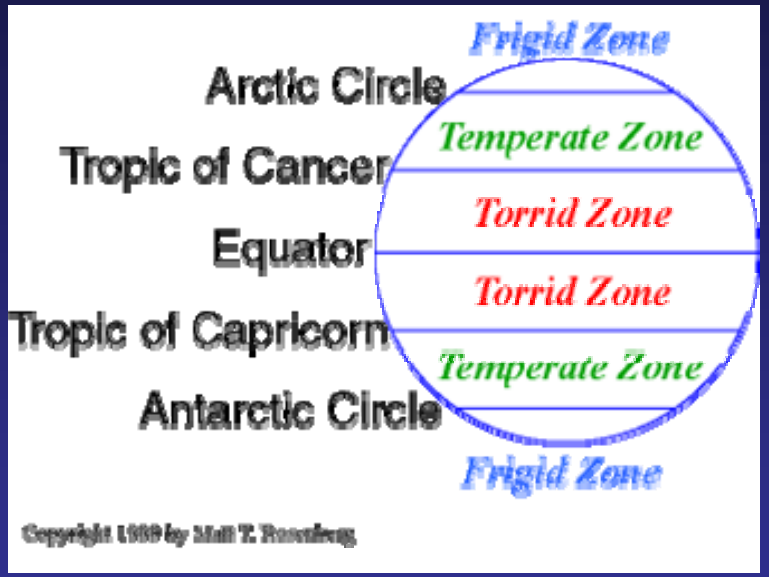
GLOBAL PRECIPITATION

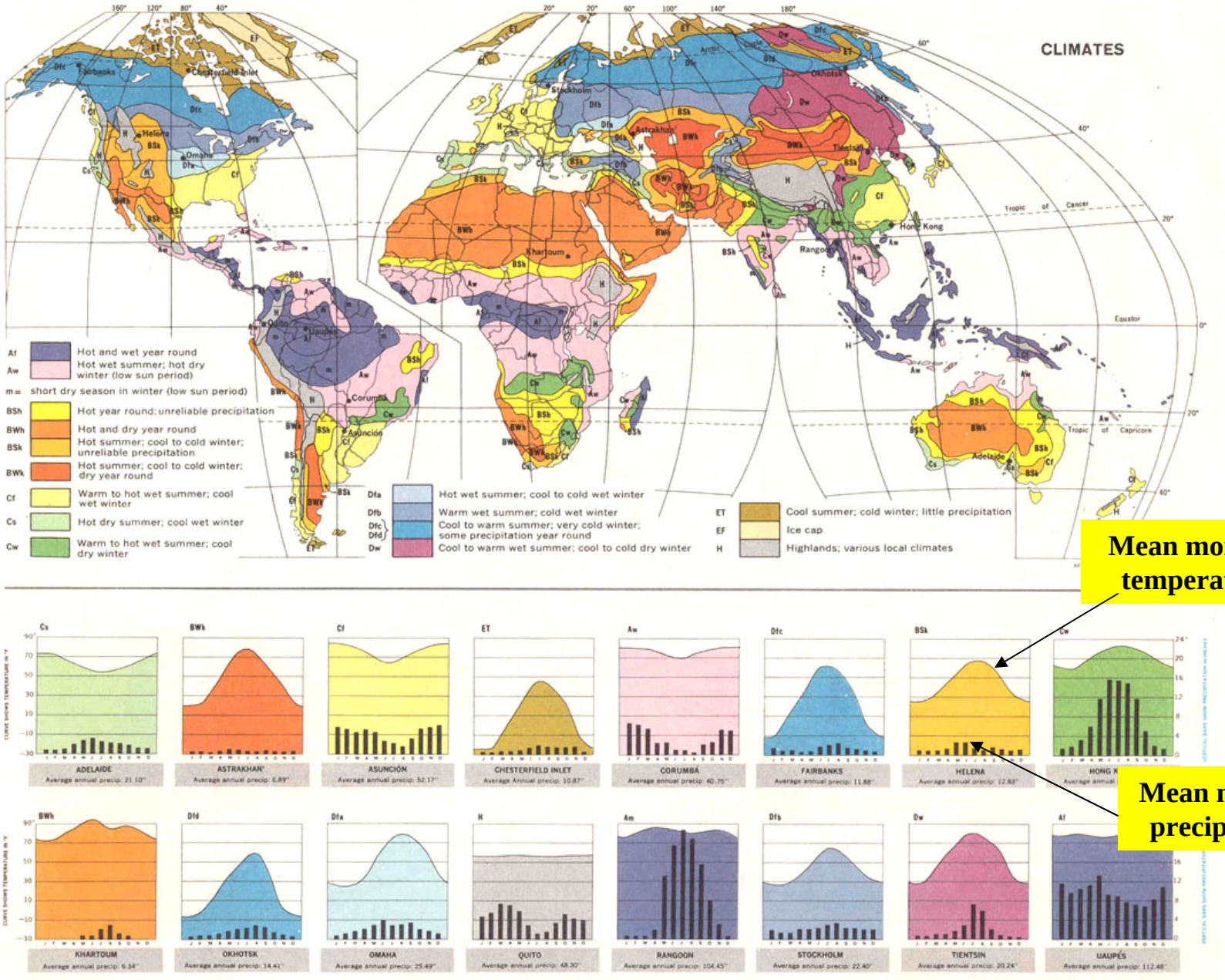


Climate Classification

Ancient Greek System

1. torrid zone
2. frigid zone
3. temperate zone

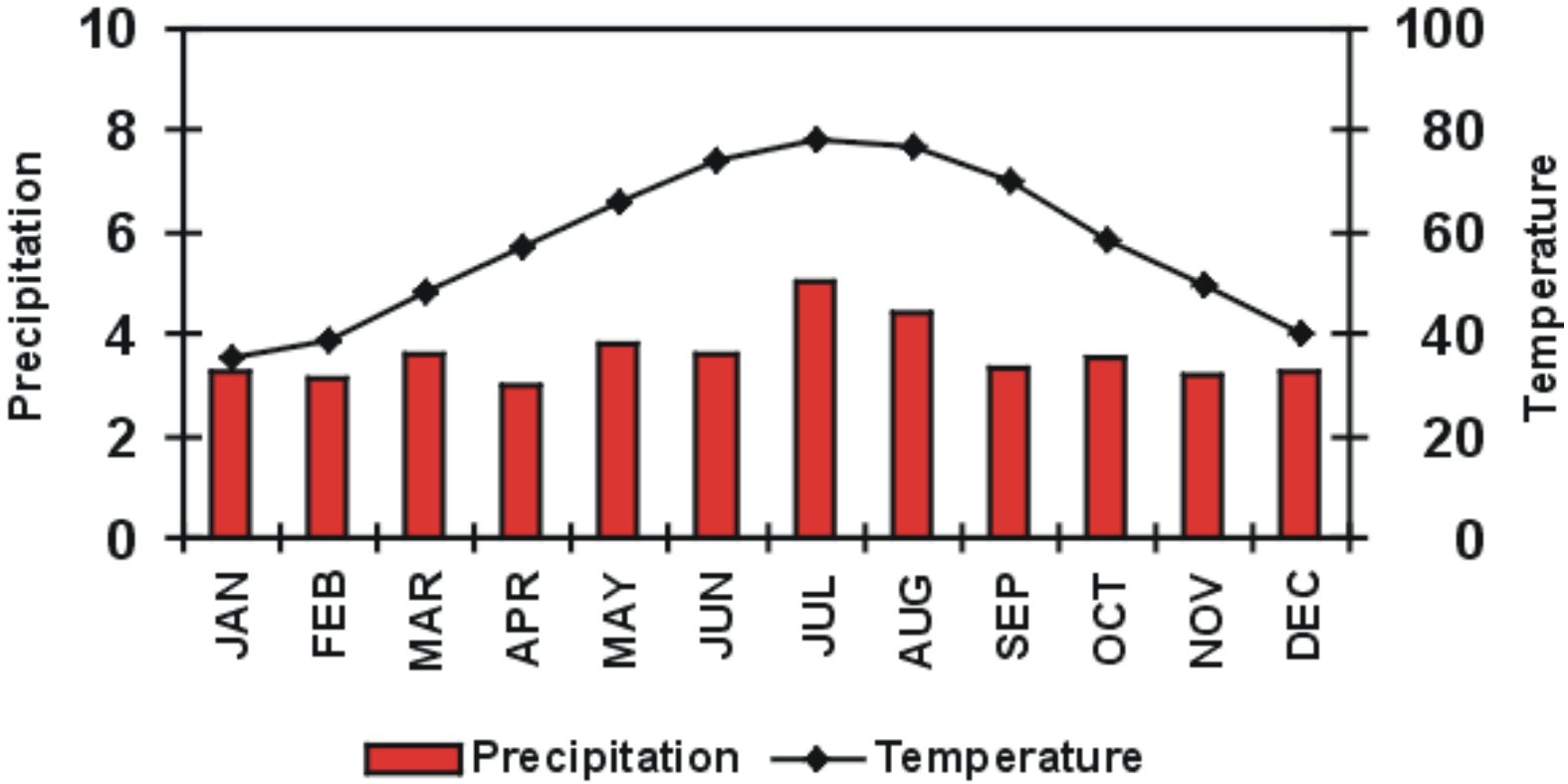




Mean monthly temperature

Mean monthly precipitation

Richmond, Virginia



Lat.: 37° 30' N
Long.: 77° 20' W
Elevation: 164 ft. asl
Total Annual Precip.: 43.16"
Avg. Annual Temp.: 57.7°F

Cfa: **humid subtropical, mild with no dry season, hot summer**

Köppen Climate Catergories = 5 major types

A: Tropical wet climates. All months have an average temperature > 18° C (64° F).

B: Dry climates. During most of the year the water budget runs a deficit (PET< Ppt).

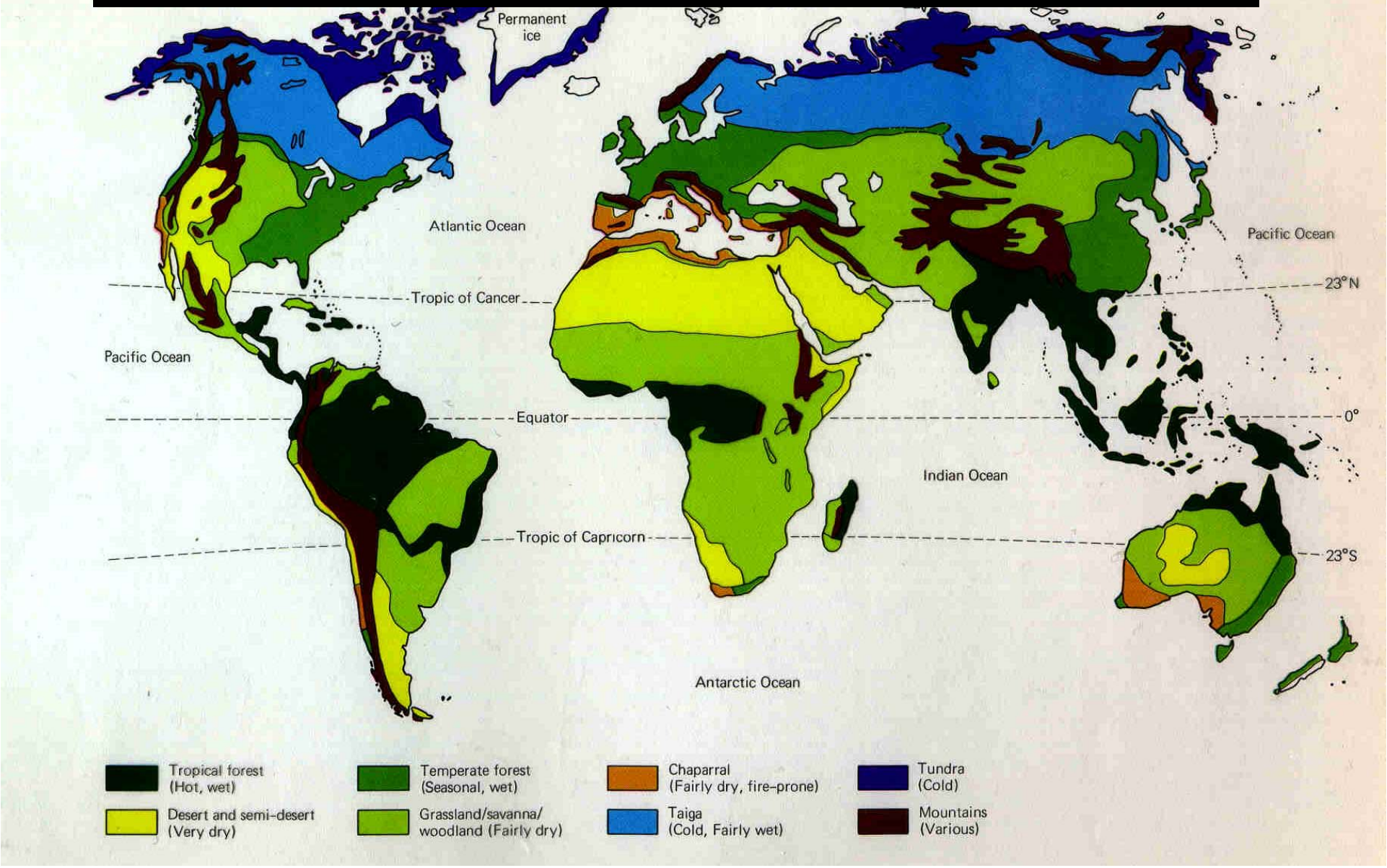
C: Humid mid-latitude climates with mild winters. The winters are mild and the summers are warm to hot. The average temperature of the coldest month is < 18° C > -3° C (27° F).

D: Humid mid-latitude climates with severe winters. The summers are warm and winters are cold. The average temperature of the coldest month is < -3° C.

E: Polar climates. The winters and summers are extremely cold. The average temperature of the warmest month is < 10° C (50° F).

H: Highland climates. Add in 1932. Regions where there is a rapid elevation change that create sharp changes in climate mimicking latitudinal changes. Thus, it is possible to find a polar climate in the tropics at high elevations.

Biomes = ***major set of species distributed over a large geographic region - considered to be the largest definable community***



Major Biome Types

1. **Grasslands*** and Savanna**
2. **Temperate Forests (includes deciduous and rain forest)**
3. **Taiga (Boreal) Forest**
4. **Tundra**
5. **Tropical Forests (includes rain and monsoon forests)**
6. **Chaparral (Mediterranean)**
7. **Desert and Semi-desert (short grass steppe)**
8. **Highland (Mountain)**

****Biomes in Blue are the four dominant biomes based on surface area covered**

Biome Boundaries

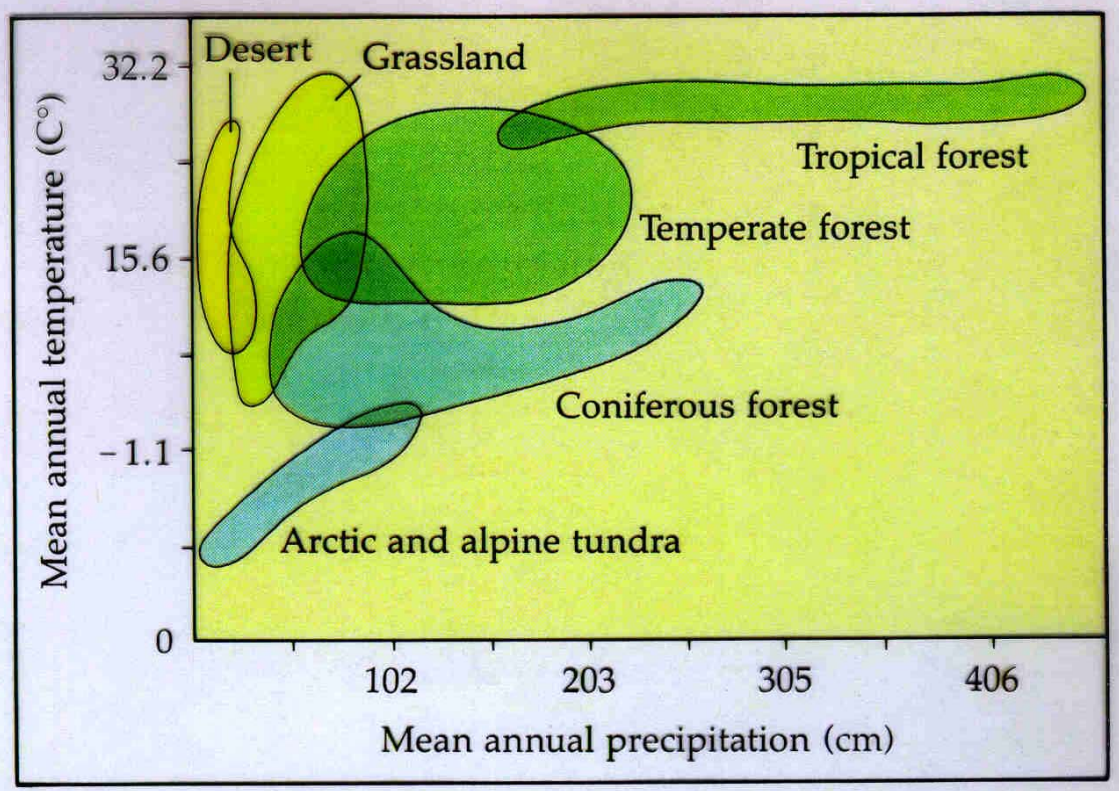


Figure 46.22
A climograph for some major North American biomes. The areas plotted here encompass the annual mean temperatures and precipitation occurring in some major North American biomes. The climograph provides only circumstantial evidence, however, that these factors are important in explaining the distribution of the biomes. The areas of overlap, for example, show that these variables alone are not sufficient to explain the observed distribution.

Distribution of Urban and Agricultural "Biomes"

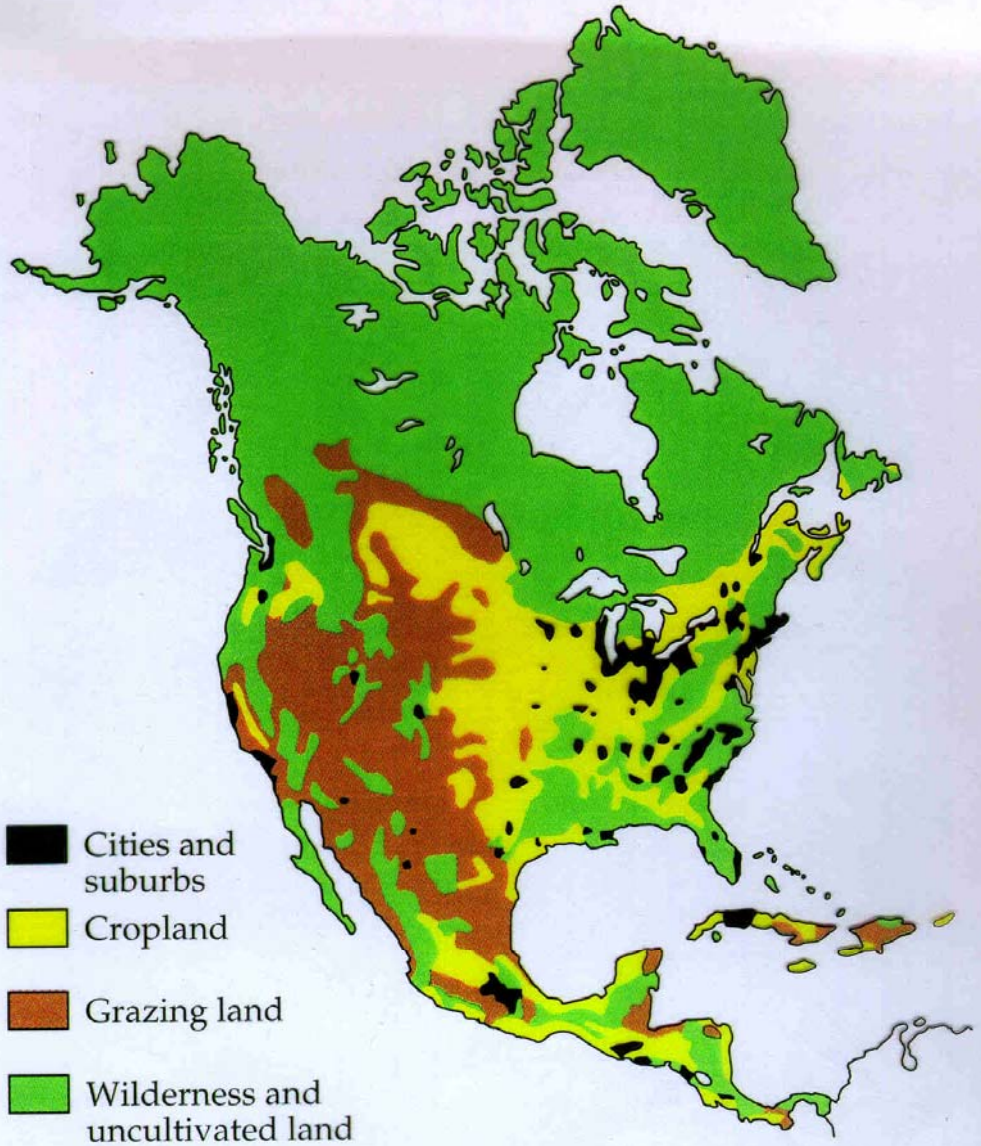


Figure 46.4
Urban and agricultural biomes. Many regions on Earth have been disturbed by intense human activity. In urban and agricultural biomes, natural communities have been replaced by housing, industry, cropland, and grazing range. Relatively few undisturbed habitats remain in most regions on the planet.

TABLE 20.2 Average Changes in Climatic Elements Caused by Urbanization

Element	Comparison with Rural Environment
Cloudiness:	
Cover	5–10% more
Fog—winter	100% more
Fog—summer	30% more
Precipitation, total	5–10% more
Relative humidity:	
Winter	2% lower
Summer	8% lower
Radiation:	
Total	15–20% less
Direct sunshine	5–15% less
Temperature:	
Annual mean	0.5–1.0°C higher
Winter minimum (average)	1.0–3.0°C higher
Wind speed:	
Annual mean	20–30% lower
Extreme gusts	10–20% lower
Calms	5–20% higher

Desertification